an addition to our knowledge of the great Calamarian family, to which the plant obviously belongs.

Further demonstrations are also given by the author, illustrating some features in the history of the true Calamites. Attention is called to the fact that, whilst the large, longitudinally-grooved and furrowed inorganic casts of the central medullary cavities of these plants are extremely common, we never find similar casts of the smaller branches. The cause of this is demonstrated in the memoir. In these young twigs the centre of the branch is at first occupied by a parenchymatous medulla. The centre of this medulla becomes absorbed at a very early age, leaving the beginnings of a small fistular cavity in its place; but, if any plastic mud or sand entered this cavity when the plant was submerged, the surface of such a cast would exhibit no longitudinal groovings, because there would be nothing in the remaining medullary cells surrounding the cast to produce such an effect. It was only when the further growth of the branch was accompanied by a more complete absorption of the remaining medullary cells, causing the cavity thus produced to be bounded by the inner wedge-shaped angles of the longitudinal vascular bundles constituting the xylem zone, that such an effect could be produced. After that change any inorganic substance finding its way into the interior of this cavity, had its surface so moulded by the wedges as to produce the superficial longitudinal ridges and furrows so characteristic of these inorganic casts.

II. "The Nitrifying Process and its Specific Ferment." By Percy F. Frankland, Ph.D., B.Sc. (Lond.), A.R.S.M., &c., Professor of Chemistry in University College, Dundee, and Grace C. Frankland. Communicated by Professor Thorpe, F.R.S. Received February 28, 1890.

(Abstract.)

The process of nitrification has been practically studied for centuries, but it was first in the year 1878 that it was shown by Schloesing and Müntz to be dependent upon the presence of certain minute forms of life, or micro-organisms, or in other words to be a fermentation change.

The authors have been engaged during the last three years in endeavouring to isolate the nitrifying organism, and the present memoir gives in detail an account of the numerous experiments which were made in this direction.

Nitrification, having been in the first instance induced in a particular ammoniacal solution by means of a small quantity of garden

soil, was carried on through twenty-four generations, a minute quantity on the point of a sterilised needle being introduced from one nitrifying solution to the other. From several of these generations, gelatine-plates were poured and the resulting colonies inoculated into identical ammoniacal solutions, to see if nitrification would ensue; but, although these experiments were repeated many times, on no occasion were they successful.

It appeared, therefore, that the nitrifying organism either refused to grow in gelatine, or that the authors had failed to find it, or that, growing in gelatine, it refused to nitrify after being passed through this medium.

Experiments were, therefore, commenced to endeavour to isolate the organism by the dilution method. For this purpose a number of series of dilutions were made by the addition to sterilised distilled water of a very small quantity of an ammoniacal solution which had nitrified. It was hoped that the attenuation would be so perfect that ultimately the nitrifying organism alone would be introduced.

After a very large number of experiments had been made in this direction the authors at length succeeded in obtaining an attenuation consisting of about $\frac{1}{1000000}$ of the original nitrifying solution employed, which not only nitrified, but on inoculation into gelatine-peptone refused to grow, and was seen under the microscope to consist of numerous characteristic bacilli hardly longer than broad, which may be described as bacillo-cocci.

These results are the more striking, for in the case of the two other bottles similarly diluted, one had not nitrified, but on inoculation into gelatine-peptone produced a growth already on the second day, whilst the remaining bottle not only produced a growth, but had also nitrified, thus clearly showing that the number of organisms had been reduced to two, *i.e.*, one which nitrified and did not grow in gelatine, and another which had nothing to do with nitrification, but which grew in gelatine. In the case where nitrification took place and a growth also appeared in the gelatine-tube, it was obvious that both the nitrifying and non-nitrifying organisms, were present. These inoculation tests, together with the microscopical appearances, were confirmed by repeated experiments with invariably the same results.

It is, however, very remarkable that, although this bacillo-coccus obstinately refuses to grow in gelatine when inoculated from these dilute media, yet in broth it produces a very characteristic growth, which, although slow in commencing, often requiring three weeks before it makes its appearance, is very luxuriant.

The authors have, moreover, been successful in inducing nitrification in ammoniacal solutions inoculated from such broth cultivations, the extent of which has been quantitatively determined.

Although microscopically its form differs slightly when grown in broth and the ammoniacal solution respectively, yet its identity was established beyond question by its returning to its characteristic bacillo-coccus form when grown again in the ammoniacal solution.

The authors have also been able to induce its tardy growth in gelatine-peptone by passing it first through broth cultivations.

The paper is accompanied by carefully executed drawings of the nitrifying organism when grown in the various media employed.

Presents, March 13, 1890.

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